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HEALTH STRUCTURE MONITORING AND TRACKING USING WSN

MOHANEESH MITKARI[1] & MARUTI LIMKAR[2]

[1]*Student of M.E. EXTC, ARMIET College, Asangaon, Mumbai, India*

[2]*Professor, Department of Electronics Engineering, Terna Engineering College, Nerul, Mumbai, India*

ABSTRACT

This paper presents the prototype design of an patient's vital status provided by smart technology. The prototype system collects vital status and sends to medical examiners in emergency or critical situations. It could also stop manual data entry which can save time. The architecture for this prototype is based on medical sensors which detect patient's vital parameters by using wireless sensor networks. The sensors gather vital status and transmit to guardian with help of GSM and GPS Module. Not only it collects data and sends to respective patients care taker but also track whether patient is fallen down or met with an accident. Therefore, one can approach very soon to save patient from any fatal occurrences. Thus it gives real time data which shows high quality services, and this policing healthcare system supports hospitals staff and also intimate patient's guardian or caretaker by continuously monitoring.

KEYWORDS: Wireless Sensor Networks, Global Position System & Health Care & Patients Tracking

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Original Article

INTRODUCTION

The need for wireless patient monitoring system and tracking gives scope of facilitating the development of medical revolution. Patient Monitoring System is a process where a medical executive or guardian can continuously monitor patient remotely and can also track its location. WSN has wide applications such as military, climate monitoring applications, underwater networks applications, and structural health monitoring applications. Though it has some limitations to power, memory, and data transmission. It is growing area as patients vital status could be monitored remotely which saves time and excess energy. Although present systems allow continuous monitoring of patient vital signs which require the sensors to be placed bedside monitor or PCs, and limit the patient to his bed. It will also reduce the complications of wired sensors which will give mobility to patient along with continuously sensors attached to the body. Embedded systems are still growing technology which touches every nook and corner of the mind. It is not feasible stay without embedded technology. When it comes to embedded system computing also comes in picture which manages technology services with minimal effort and cost. This system or prototype gives us a convenience of wireless where we avoid dealing with wired or running cables to and from devices in order to interconnect them, and wireless devices can be moved to any location within the transmission range while still being able to communicate and broadcast data. Due to this it is expected wireless data communication will become even more popular and more extensively used in the medical field. Currently the most popular method of wireless communications is radio frequency transmission. As these devices have a very low power consumption and power output, perhaps more importantly devices can achieve good data transmission rates. This prototype technology has several advantages such as flexibility, highly auto-mated, low cost, fast services providing, and a huge storage capacity.

MOTIVATION

A healthcare service is basic and important for those who suffer chronic issues. Thus they needed to be continuously monitored or examine. With the help of wireless technology we can build a new smart health system which could help to achieve high quality health care services. Wireless technology is emerging as a significant element of next generation healthcare services [6]. Below reasons motivates to create such prototype for societal benefit and they are (1) making healthcare more accessible for people who do not have access to healthcare providers in their communities; (2) making healthcare convenient for people who have less access to public transportation in order to go to hospitals; (3) increasing bed capacity in hospitals, especially during public events where a huge number of people are gather at one place; (4) giving medical staff more time to be attentive to patients who need more care; (5) preventing delays in the arrival of patients vital status to the healthcare providers, like in accident and emergency situations; and (6) reducing manual data entry for patients data which prevents real-time monitoring and restricts medical staff to monitor their patients efficiently

LITERATURE SURVEY

A Health care monitoring and tracking system using WSN comprises battery-powered sensor nodes with extremely limited processing capabilities. This saves time, energy of medical staff from manual data entry and also monitors the patient's health status. With a sensors radio communication range, wirelessly sends messages to a base station and then to users interface. Design and implementation of an smart networked system can help to solve delays on arrival of patient's medical information to healthcare providers, particularly in accident and emergency case. The non-intrusive healthcare system was designed based on wireless sensor network for wide area coverage with minimum battery power to support wireless transmission. They have developed various devices such as wearable ubiquitous sensor network (USN) node, wearable chest sensor belt and wrist pulse oximeter for this system [2]. It demonstrates that wireless body-centric sensing systems have an important role in the fields of biomedicine, personal healthcare, safety, and security. WSN is important wireless technologies that have a wide variety of applications and provide limitless future potentials. RFID facilitates detection and identification of objects that are not easily detectable or distinguishable by using current sensor technologies. However, it does not provide information about the condition of the objects it detects. Sensors, on the other hand, provide information about the condition of the objects as well as the environment. With the advancement of wireless technology, wireless devices can be used to reduce medical errors, increase medical care quality, improve the efficiency of caregivers, lessen the caregiver-lacking situation, and improve the comfort of patients [11].

BLOCK DIAGRAM AND DESCRIPTION

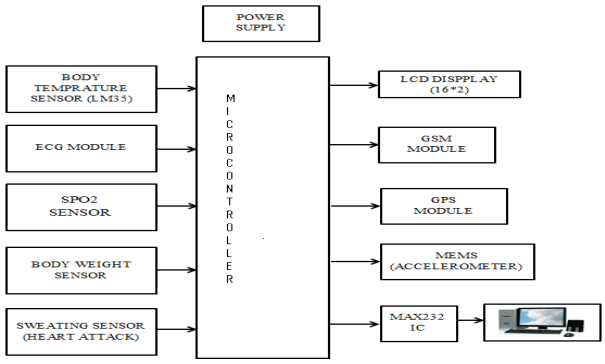

Figure 1: Block Diagram of Proposed Health Structure Monitoring and Tracking Using WSN

The Proposed System focuses on the kind of more technology enabled and fast result oriented so that time could be saved. In this prototype tracking of the patients is done by using accelerometer which helps to track the status of patient. The Global Positioning System (GPS) is a space-based navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. Above figure shows system block diagram which comprises of Microcontroller, six sensors i.e, Body temperature, ECG module/Heart rate, SPO2 sensor, Load cell sensor, Sweating sensor. On other part to track the patient's location, GPS module, GSM module, Accelerometer is used. Also to get the display LCD and MAX 232 IC is used. We can register each entity user, caretaker, doctor and nurse in system for authentication. Providing health care services are very important for people especially, who have chronic diseases.

HARDWARE UNITS

- **Sensor Units:** In this unit sensors are attached to Microcontroller. The sensors which used are SPO2, Body Temperature, Sweating Sensor, Load Cell/Body Weight, and ECG/Heart Rate. These sensors will detect the abnormal changes in body and transmit to microcontroller.
- **Controller Unit:** The microcontroller receives the data from sensors processes it and displays it on LCD as well as sends message to patient's guardian or doctor.
- **GSM Unit:** The GSM standard has been an advantage to both consumers, who gets benefit from the ability to roam and switch carriers without replacing phones, and also to network operators, who can choose equipment from many GSM equipment vendors.
- **GPS Unit**: The signals are broadcasted by satellites from space that GPS receivers, use to provide three-dimensional location (latitude, longitude, and altitude) plus precise time. GPS gives trustable and reliable timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth. ultra-sensitive GPS receiver can acquire GPS signals from 65 channels of satellites and output position data with high accuracy in extremely challenging environments and under poor signal conditions due to its active antenna and high sensitivity.
- **Tracking Unit:** For tracking the patient's status we are using accelerometers so that we can know whether the patient has met with any accident. If patient falls down the alert/message will be sent on patient's guardian.
- **Power Supply:** Power supply is the first and the most important part of our project. The Mains 230 VAC is supplied to step down transformer and its rectified and filtered output is regulated o/p 12VDC.

  In our prototype project we need +5V regulated power supply. The mains 230VAC is supplied to step down transformer then it is rectified, gets filtered and three terminal voltage regulator is connected, through which the regulated o/p is drawn.
- **LCD Display:** LCD is a type of display used in digital watches and many portable computers. An electric current passed through the liquid causes the crystals to align so that light cannot pass through them. LCD technology has advanced very rapidly since its initial inception over a decade ago for use in laptop computers. Technical achievement has resulted in brighter displace, higher resolutions, reduce response times and cheaper manufacturing process.

- **MAX232:** Serial data is any data that is sent one bit at a time using a single electrical signal. The parallel data is sent 8, 16, 32, or even 64 bits at a time using a signal line for each bit. The data is transmitting without the use of a master clock is said to be asynchronous serial data. This is use to interface laptop or computer screen so that we can have availability of results on screen.

Software Tools

The tools used to get the results on laptop are terminal or, even putty software can be used for viewing results. The serial cable is connected from board to laptop or PC. Now on PC or laptop side we can install the terminal or putty along with drivers so that we can make communication between board and laptop. Microcontroller only understands 0s and 1s and unfortunately we cannot write code in this format. Hence we require a interpreter who will tell our expected task sequence or algorithm to microcontroller.

CIRCUIT DIAGRAM AND DESCRIPTION

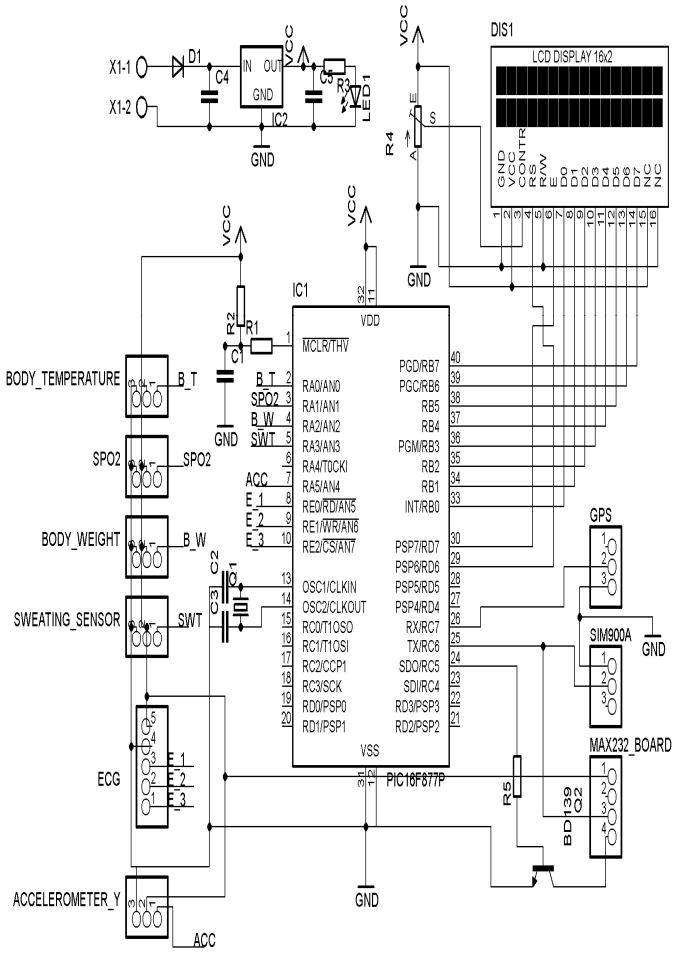

Figure 2: Circuit Diagram

When a sensor connected to body, senses the abnormal condition and transmits to microcontroller. The normal body temperature is 38 degree celcius. If body temperature goes beyond that, say 41 degree c then body temp sensor will sense the abnormality and transmit data to microcontroller. Spo2 sensor will sense the normal pulse oximetry i.e ranges between 75 to 100 mm Hg and display on LCD. The Body weight sensor will detect weight of patient and display on LCD "YES". From this we can know that patient is whether present on bed or not. The Sweating Sensor detects through sweat of

the human body, as sweat is good conductor of electricity due to contains of water and salt. The ECG sensor senses abnormal condition of patient which goes above 82 to 100 bpm, it will transmit to microcontroller and then microcontroller to LCD and on mobile. For tracking the patient's status accelerometer sensor is used. Whenever the patient falls on ground or lose balance while walking or any other circumstances like dizziness etc, it will sense the abnormality and data will be send to microcontroller which again with help of GSM and GPS module the patient's guardian or personal doctor can achieve via mobile message "ACCIDENT". There are three conditions shown below.

Condition 1: Fever

It is only dependent on the value of temperature sensor. If temperature sensor reports a value greater than 41 degree Celsius, then we call it as a fever.

Condition 2: Heart Attack

It is dependent on simultaneous values of three sensors. Heart rate sensor, Sweating sensor and on bed sensor. If heart beats are more then 83, sweating and patient is on bed then we can say it as the heart attack probable condition. Now if we only depend on heart rate, then some times because of some excitation and medicines, heart rate may increase. Hence sole value of increase in heart rate cannot predict heart attack. The need of bed and sweating sensor together is, if patient is not on bed, then due to external conditions, the hard work done, he or she may have sweating. Hence we need to monitor if patient is on bed or not.

Condition 3: Accident

If the Accelerometer ADXL335 reports very abrupt acceleration then we call it as accident.

SPO2 sensor that we are using is dependent on Light. If sensor is not attached with patient body, and if light conditions are suitable, SPO2 may give a false trigger output. Such false triggering outputs are risky and should be avoided for true indications.

ALGORITHM

The algorithm is described in 36 steps.

Step 1: Start

Step 2: Initialize ADC, UART and program variables.

Step 3: check the value of temperature.(LM35)

Step 4: compare it with threshold value. if threshold value is less then put FEVER mark

Step 5: display the temperature on LCD

Step 6: Send the temperature value over UART

Step 7: check the value of Movement sensor (ADXL335 Accelerometer)

Step 8: compare it with threshold value. if threshold value is less then put ACCIDENT mark.

Step 9: display the status on LCD

Step 10: Send the status over UART

Step 11: check the value of Sweating sensor

Step 12: compare it with threshold value. if threshold value is less then put SWEATING mark.

Step 13: display the status on LCD

Step 14: Send the status over UART

Step 15: check the value of Weight Sensor (Load Cell)

Step 16: compare it with threshold value. if threshold value is less then put ON_BED mark.

Step 17: display the status on LCD

Step 18: Send the status over UART

Step 19: check the value of Heart beat sensor (ECG)

Step 20: compare it with threshold value. if threshold value is less then put HEART_BEAT mark.

Step 21: display the heart beat value on LCD

Step 22: Send the heart beat value over UART

Step 23: check the value of spo2 (SPO2 sensor)

Step 24: compare it with threshold value. if threshold value is less then put SPO2 mark.

Step 25: display the value on LCD

Step 26: Send the value over UART

Step 27: check for gps coordinates

Step 28: if available, then record Latitude, latitude direction, longitude, and longitude direction.

Step 29: if available then display this coordinates on LCD else display 0

Step 30: if available then Send this coordinates to UART else send 0

Step 31: check for marks. Set msg text to null.

Step 32: if ACCIDENT mark found, put Accident and GPS coordinates in msg text

Step 33: if FEVER mark found, put Fever in msg text

Step 34: if HEART BEAT, ON_BED and SWEATING all three marks found, put heart attack in msg txt.

Step 35: if msg txt is not empty, send msg to all the numbers one after another.

Step 36: go to step 2 and repeat.

COMPARISON

Table 1: Comparison between Existing Wired System and Proposed Wireless System

Sr No	Existed System	Proposed System
1	Installation is clumsy and time consuming.	Easy installation as less wired, neat, clean.
2	Networks are invisible to other wired networks	Network is visible to other wireless networks

Table 1: Contd.,		
3	Mobility in wired network is less or limited.	Outstanding mobility as it is wireless.
4	Connectivity is possible till cable could extend	Connectivity is possible beyond bounds of physical network cabling
5	Fibers and ethernet cables are used.	Radio and microwave communication is done
6	Hubs and switches are needed.	No need of hubs and switches

RESULTS

Table 2

Sr.	Parameters	Message on Conditions
1.	ECG/HEART RATE 60 TO 100 bpm	HEAR ATTACK
2.	Body Weight/ Presence on bed	
3.	Sweating Sensor	
4.	Body Temp	FEVER
5.	Accelerometer	ACCIDENT

For SPO2, the result will display on LCD and not via message and reason is already explained.

Project prototype

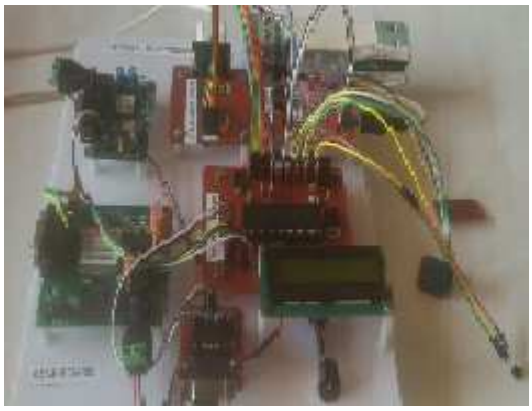

Figure 3: Project Prototype

CONCLUSIONS

The integration between wireless sensor networks and data servers will create a new generation of technology in many aspects such as patient monitoring with minimal cost, reducing the number of occupied beds in hospitals, and improving medical staff performance. This system can be demonstrated to operate successfully in healthcare system according to communication, monitoring and tracking without any disturbance to daily life of patient. This design will able to collect data of body temperature, pulse rate, heart rate, oximeter level, body weight, sweating sensor and also tracking patients status whether he is fallen or met with an accident. The mobile communication is a key component in these systems, as it creates the communication link between sensors and the surrounding environment.

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